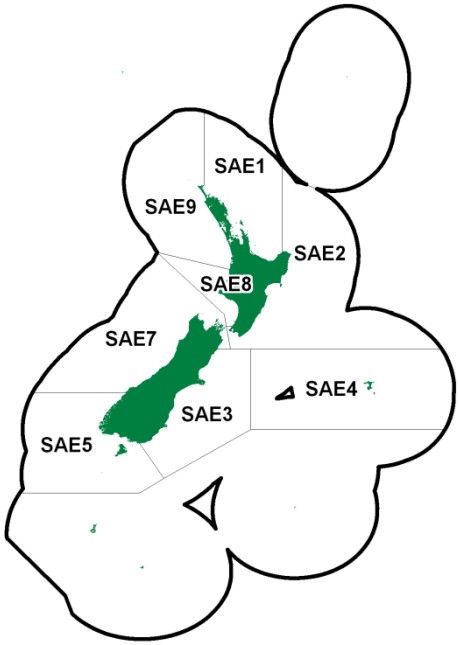
TRIANGLE SHELL (SAE)

(*Spisula aequilatera*)



1. FISHERY SUMMARY

This species is part of the surf clam fishery and the reader is guided to the surf clam introductory chapter for information common to all relevant species.

Triangle shells (*Spisula aequilatera* (also known as *Crassula aequilatera*)) were introduced into the QMS on 1 April 2004 with a total TACC of 406 t. No allowances were initially set for customary, non-commercial, recreational or other sources of mortality, but some allowances were introduced to SAE 8 and 7 in 2013 and 2016, respectively. Biomass surveys supported an increase in TAC in SAE 2 and SAE 3 from 1 April 2010 from 1 and 264 t respectively to 132 and 483 t, respectively. A subsequent biomass survey in SAE 8 resulted in a TAC increase from 8 to 1821 t in April 2013. Another biomass survey resulted in an increase in the SAE 7 TAC from 112 t to 235 t in April 2016, with a current total national TAC of 2692 t (Table 1).

Table 1: Current TAC, TACC and allowances for other sources of mortality for *Spisula aequilatera*

Fishstock	TAC (t)	TACC (t)	Recreational allowance (t)	Customary Allowance (t)	Other sources of mortality (t)
SAE 1	9	9	0	0	0
SAE 2	132	125	0	0	7
SAE 3	483	459	0	0	24
SAE 4	1	1	0	0	0
SAE 5	3	3	0	0	0
SAE 7	235	217	1	5	12
SAE 8	1821	1720	0	10	91
SAE 9	8	8	0	0	0
Total	2692	2542	1	15	134

1.1 Commercial fisheries

Apart from a small catch in SAE 2 in 2003–04 and small catches in SAE 3 since 2006–07, all reported landings have been from SAE 7. Between the 1991–92 and 1995–96 fishing years, landings were small and no further landings were reported until 2002–03. Landings fluctuated from 2002–03 until 2009–10, since then they have increased each year to reach 241 t in 2014–15. Reported landings and TACCs are

shown for the fishstocks with historical landings in Table 2. Figure 1 shows historical landings and TACCs for the two main SAE stocks. Landings are market-driven and have not been constrained by the TACCs.

Table 2: TACCs and reported landings (t) of Triangle shell by Fishstock from 1990–91 to 2015–16 from CELR and CLR data. See Table 1 for TACC of stocks not landed.

	SAE 2		SAE 3		SAE 7		SAE 8		Total	
Fishstock	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
1991–92	0	-	0	-	0.175	-	0	-	0.175	-
1992–93	0	-	0	-	0.396	-	0	-	0.396	-
1993–94	0	-	0	-	2.846	-	0	-	2.846	-
1994–95	0	-	0	-	2.098	-	0	-	2.098	-
1995–96	0	-	0	-	0.12	-	0	-	0.120	-
1996–97	0	-	0	-	0	-	0	-	0	-
1997–98	0	-	0	-	0	-	0	-	0	-
1998–99	0	-	0	-	0	-	0	-	0	-
1999–00	0	-	0	-	0	-	0	-	0	-
2000–01	0	-	0	-	0	-	0	-	0	-
2001–02	0	-	0	-	0	-	0	-	0	-
2002–03	0	-	0	-	52.146	-	0	-	52.146	-
2003–04	0.198	1.0	0	264.0	9.583	112.0	0	8	9.781	406.0
2004–05	0	1.0	0	264.0	18.527	112.0	0	8	19.364*	406.0
2005–06	0	1.0	0	264.0	28.067	112.0	0	8	31.019*	406.0
2006–07	0	1.0	0.608	264.0	45.955	112.0	0	8	46.563	406.0
2007–08	0	1.0	3.912	264.0	5.022	112.0	0	8	8.934	406.0
2008–09	0	1.0	10.909	264.0	2.506	112.0	0	8	13.415	406.0
2009–10	0	1.0	8.619	264.0	1.460	112.0	0	8	10.078	406.0
2010–11	0	125.0	4.043	459.0	16.919	112.0	0	8	20.962	725.0
2011–12	0	125.0	0	459.0	82.266	112.0	0	8	82.266	725.0
2012–13	0	125.0	9.832	459	161.195	112.0	0	1 720	171.027	2 437.0
2013–14	0	125.0	3.613	459	191.073	112.0	0	1 720	195.316	2 437.0
2014–15	0	125.0	5.924	459	241.037	112.0	0.445	1 720	246.961	2 437.0
2015–16	0	125.0	34.97	459	319.090	217.0	21.02	1 720	375.092	2 867.0

*In 2004–05 and 2005–06, 0.837 and 2.952 t respectively were reported landed, but the QMA is not recorded. These amounts are included in the total landings for these years.

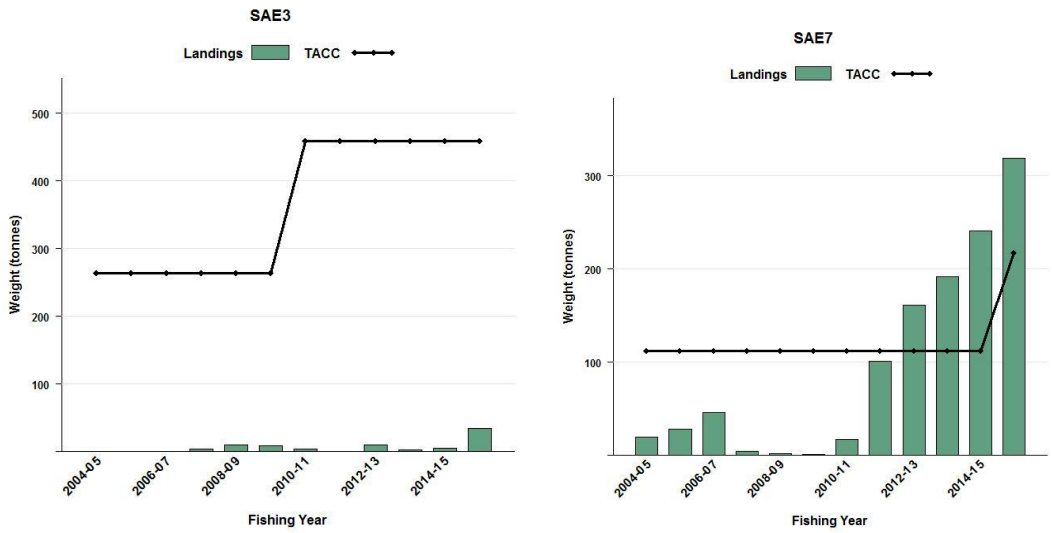


Figure 1: Reported commercial landings and TACC for selected areas.

1.2 Recreational fisheries

There are no estimates of recreational take for this surf clam.

1.3 Customary fisheries

Shells of this species have been found irregularly, and in small numbers in a few middens (Carkeek 1966). There are no estimates of current customary catch of this species.

1.4 Illegal catch

There is no documented illegal catch of this species.

1.5 Other sources of mortality

There is no quantitative information on other sources of mortality, although this clam is subject to localised catastrophic mortality from erosion during storms, high temperatures and low oxygen levels during calm summer periods, blooms of toxic algae and excessive freshwater outflow (Cranfield & Michael 2001).

2. BIOLOGY

S. aequilatera occurs from Bay of Plenty southwards on the east coast of both islands, and on the Wellington-Manawatu coast. No information is available concerning its distribution on the West Coast of the South Island. In the North Island this species is most abundant between 3 m and 5 m depth, and in the South Island between 4 m and 8 m depth. Maximum length is variable between areas, ranging from 39 to 74 mm (Cranfield & Michael 2002). The sexes are separate; they are broadcast spawners; they are reasonably fast growing and reach maximum size in 2–3 years. Nothing is known of their larval life.

3. STOCKS AND AREAS

For management purposes stock boundaries are based on FMAs, however, the boundaries of stocks of surf clams are likely to be the continuous lengths of exposed sandy beaches between geographical features (rivers, headlands, etc). Circulation patterns may isolate surf clams genetically as well as ecologically.

4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

See the introductory surf clam chapter.

5. STOCK ASSESSMENT

5.1 Estimates of fishery parameters and abundance

No estimates of fisheries parameters or abundance are available for this species. Early estimates were made of M and $F_{0.1}$ but the SFWG considers that the methods were not well documented, and the estimates should not be used.

5.2 Biomass estimates

Biomass has been estimated from SAE 2, 3, 7 and 8 at a variety of dates from 1994 to 2015 using stratified random surveying with a hydraulic dredge. Survey size has been expressed either as length of beach (Table 3), or as area (Table 4), which makes comparisons difficult.

Table 3: A summary of biomass estimates in tonnes greenweight with standard deviation in parentheses from exploratory surveys of Cloudy Bay (Cranfield et al 1994b) and Clifford Bay in Marlborough (Michael et al 1994), and Foxton beach on the Manawatu coast (White et al 2012).

Area	Cloudy Bay (SAE 7)	Clifford Bay (SAE 7)	Foxton Beach (SAE 8)
Length of beach (km)	11	21	46[#]
Biomass (t)	53 (22)	358 (152)	7993 (759)[#]

[#] Biomass was estimated at Foxton Beach from a mix of a systematic survey in the North and a stratified survey in the South of this location.

Table 4: A summary of biomass estimates in tonnes greenweight from the surveys in SAE 2 (Triantifillos 2008b), SAE 3 (Triantifillos 2008a) and Cloudy Bay (White et al 2015). Unless otherwise stated the CV is less than 20%.

Location	Five sites (SAE 2)	Ashley River to 6 nm south of the Waimakariri River (SAE 3)	Cloudy Bay (SAE 7)
Area surveyed (km^2)	28.0	13.4	5.7
Biomass (t)	471.1	1567.2	887

5.3 Yield estimates and projections

Estimation of Maximum Constant Yield (*MCY*)

Growth and mortality data from Cloudy Bay in Marlborough and the Kapiti Coast in Manawatu (Cranfield et al 1993) have been used in a yield per recruit model to estimate the reference fishing mortality $F_{0.1}$ (Cranfield et al 1994b). The shellfish working group (SFWG) did not accept these estimates of $F_{0.1}$ as there was considerable uncertainty in both the estimate and the method used to generate them. The *MCY* estimates of Triantifillos (2008a and b) and White et al (2012, 2015) that use the full range of $F_{0.1}$ estimates from Cranfield et al (1993) are shown in Table 5. The SFWG recommended that MCY estimates are adequate to use to inform management decisions relevant to all surf clam fisheries, with the following caveats: 1) due to high uncertainty in the $F_{0.1}$ values for SAE, the SFWG advised using the lower $F_{0.1}$ values when estimating a sustainable MCY for this species, 2) there is a need to account for any substantial catch that has already come out of any surf clam fishery when estimating MCY, however there was no consensus on the best way to do this, and 3) an exploitation rate of 34% for SAE 7 (as suggested by the higher MCY value) was not recommended due to our current limited knowledge of the dynamics of surf clam species.

Estimates of *MCY* are available from a number of locations and were calculated using Method 1 for a virgin fishery (MPI 2015) with an estimate of virgin biomass B_0, where:

$$MCY = 0.25 * F_{0.1} B_0$$

Table 5: *MCY* estimates (t) for *S. aequilatera* from virgin biomass at locations sampled around New Zealand (Triantifillos 2008a and b). The two $F_{0.1}$ values, which are subsequently used to estimate MCY, are the minimum and maximum estimates from Cranfield et al. (1993).

Location	$F_{0.1}$	*MCY*
Five sites (SAE 2)	1.12/1.56	131.9/183.7
Ashley River to 6 nm south of the Waimakariri River (SAE 3)	1.06/1.37	415.3/536.8
Cloudy Bay (SAE 7)	1.06/1.37	235.0/303.8
Foxton beach (SAE 8)	1.06/1.37	2238/3117.2

Estimation of Current Annual Yield (*CAY*)

CAY has not been estimated for *S. aequilatera*.

The SFWG recommended moving all surfclam fisheries away from an MCY management strategy and towards an exploitation rate management strategy. The SFWG recognised that an exploitation rate approach is more survey intensive, but better allows for the variable nature of biomass for surf clams as it allows greater flexibility in catch (in order to take greater landings from available biomass) whilst keeping catches sustainable.

6. STATUS OF THE STOCKS

- SAE 2, 3, & 8- *Spisula aequilatera*

Stock Status	
Year of Most Recent Assessment	2008 for SAE 2 and 3, 2012 for SAE 8.
Assessment Runs Presented	Survey biomass
Reference Points	Target: Not defined, but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: -
Status in relation to Target	Because of the relatively low levels of exploitation of *S. aequilatera*, it is likely that all stocks are still effectively in a virgin state, therefore they are Very Likely (> 90%) to be at or above the target.
Status in relation to Limits	Very Unlikely (< 10%) to be below the soft and hard limits
Status in relation to Overfishing	Overfishing is Very Unlikely (< 10%) to be occurring
Historical Stock Status Trajectory and Current Status -	

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Unknown
Recent Trend in Fishing Mortality or Proxy	Fishing is light in all QMAs.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	-
Probability of Current Catch or TACC causing decline below Limits	For all stocks current catches are Very Unlikely (< 10%) to cause declines below soft or hard limits in the short to medium term.
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Very Unlikely (< 10%)

Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Absolute biomass estimates from quadrat surveys	
Assessment Dates	Latest assessment: 2008 for SAE 2 and 3, 2012 for SAE 8.	Next assessment: Unknown
Overall assessment quality rank	-	
Main data inputs (rank)	Abundance and length frequency information	
Data not used		
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	

Qualifying Comments
Stock size could fluctuate markedly as a result of catastrophic mortality from a number of causes. There is a need to review the fishery parameters for this species. SAE have slower digging ability relative to PDO therefore are at higher relative risk of mortality during storms.

Fishery Interactions
SAE can be caught together with other surf clam species and non-QMS bivalves.

- SAE 7

Stock Status	
Year of Most Recent Assessment	2015.
Assessment Runs Presented	Survey biomass
Reference Points	Target: Not defined, but B_{MSY} assumed Soft Limit: 20% B_0 Hard Limit: 10% B_0
Status in relation to Target	Very likely (> 90%) to be at or above the target
Status in relation to Limits	Unlikely (< 40%) to be below the soft and hard limits
Status in relation to Overfishing	Overfishing is Unlikely (< 40%) to be occurring
Historical Stock Status Trajectory and Current Status -	

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Unknown
Recent Trend in Fishing Mortality or Proxy	Fishing was variable between 52 and 1 t landed between 2002–03 and 2009–10, with single digit tonnages taken between 2007–08 and 2009–10. Since then landings have increased dramatically from 1 t in 2009–10 to 241 t in 2014–15, which was more than double the TACC.
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	-
Probability of Current Catch or TACC causing decline below Limits	Current catches at or below the TACC are Unlikely (< 40%) to cause declines below soft or hard limits in the short to mid-term.
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Unlikely (< 40%)

Assessment Methodology		
Assessment Type	Level 2 - Partial Quantitative Stock Assessment	
Assessment Method	Absolute biomass estimates from quadrat surveys	
Assessment Dates	Latest assessment: 2015	Next assessment: Unknown
Overall assessment quality rank	-	

Main data inputs	Abundance and length frequency information	
Data not used	-	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	

Qualifying Comments
Stock size could fluctuate markedly as a result of catastrophic mortality from a number of causes. There is a need to review the fishery parameters for this species. SAE have slower digging ability relative to PDO therefore are at higher relative risk of mortality during storms.

Fishery Interactions
SAE can be caught together with other surf clam species and non-QMS bivalves.

For all other SAE stocks there is no current evidence of appreciable biomass.

7. FOR FURTHER INFORMATION

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